With compliments
Helmut Singer Elektronik
www.helmut-singer.com

IEEE 488 IEC 625

60 MHz digital storage oscilloscopes

PM 3310 (clock frequency 50 MHz)

PM 3311* (clock frequency 125 MHz)

60 MHz/10mV

4 memories each 256 x 256

Digital delay −9... +9999 div.

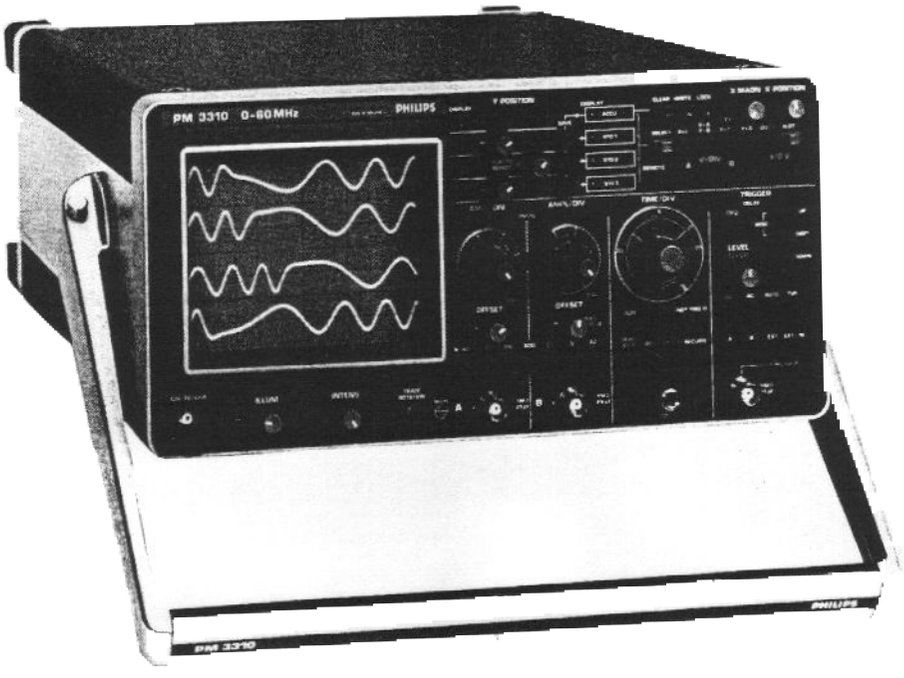
Roll mode up to 60min./div.

Display of stored signal parameters viewable simultaneously with stored signal

Plot-output

IEC/IEEE-bus compatible

The PM 3310 and PM 3311 are digital storage oscilloscopes which offer a quite unique range of display and analysis facilities. Basically, they "sample" the signal in order to make the analog-to-digital converion and then store the digital signal in a semiconductor memory. Unlike conventional storage which fades away, this technique offers the facility of **permanent** storage plus the ability to change certain display parameters **after** the signal has been captured.
In this type of instrument different signals, or different parts of the same signal, can be placed in one of four memories and be displayed simultaneously. And since both channels can be stored, this allows up to 8 traces to be displayed.



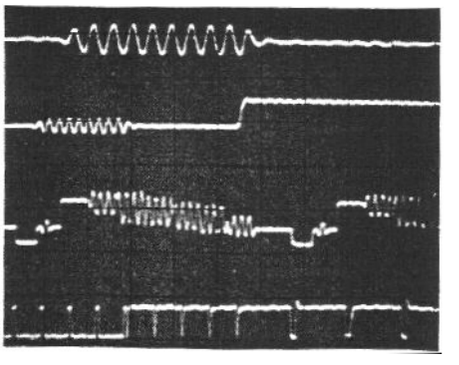
Analog-to-digital converter

The heart of the oscilloscope is the analog-to-digital converter (ADC).
In the PM 3310/11 it converts the analog signal into a 256 x 256 dot matrix. The horizontal position of the dots is determined by the clock frequency and the vertical by a series of binary digits, the values of which correspond to the analog value of the signal at the time of the relevant clock pulse.
The PM 3311 can capture and display any single shot phenomenae up to 12.5 MHz with only a limited risk of loosing signal details. However, in most cases a correct display is obtained for signals as high as 30 MHz (125 MHz ÷4) without the assumption that the signal is sine or square wave.
The track and hold circuit in the input circuit of the instrument ensures that the full 8-bit vertical resolution can be achieved also at the maximum sampling frequency of the system.
Where a signal is known to be a sinewave the stored data can be transferred via the IEC-Bus and the single-shot waveform calculated for frequencies up to 60 MHz.
The PM 3311 offer the possibility to analyze signal details providing **four** memories and a −9 to +9999 digital delay, which effectively stretches the memory capacity of the instrument.
The combination of these two facilities can be used in a variety of ways to open up totally new display and measurement possbilities.

TV triggering example

Although it is somewhat specialised, the following TV triggering example illustrates the concept. The oscilloscope is set to trigger on the frame pulse and the conventional signal (bottom trace) is obtained. By setting the relevant delay, line can be picked out and displayed as in the second trace; for example one or more of the first or last 25 lines which carry VITs/Teletext and Viewdata. Also, by changing the time/div. setting, the highly detailed display of the colour burst in the third trace can be obtained. Moreover the delay can be adjusted to run up and down all 625 lines.
This latter feature is of particular value in data streams as it enables a display window to be moved forwards and backwards relative to the trigger signal. The similar but very limited facility called pre- and post-trigger should not be confused with the instruments' digital delay, which in fact renders these terms obsolete.

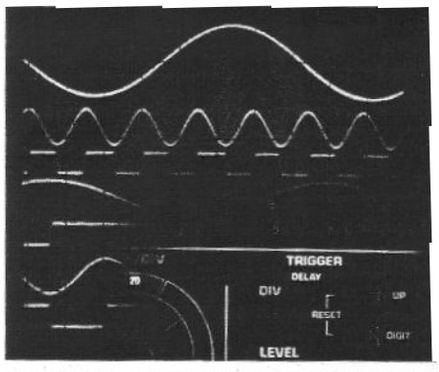
Further digital features of the PM 3310/11 include the detailed display of front panel settings at the instant the signal was captured.



Versatile digital display facility allows TV colour burst to be picked out from selected line.

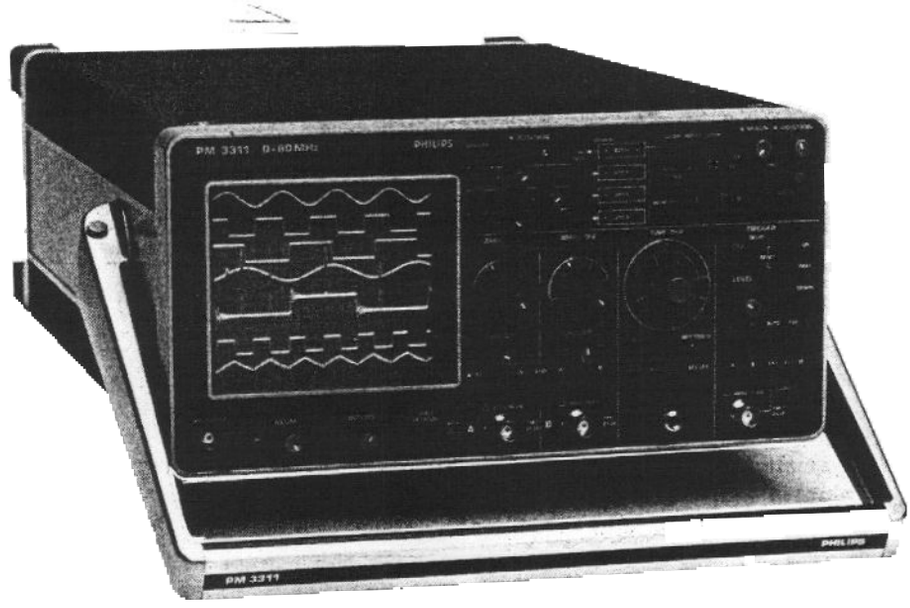
Self-diagnosis
Initially all LEDs light up as part of a self-diagnostic routine. Depending on the previous application the instrument will either show the last stored signal(s) or the LED display will indicate NOP (Not OPerative). It should be noted that stored signals are totally static.
"Live" signals in the "RECURR" mode, which refresh the memory following each trigger signal, have a miniscule movement to indicate the difference.

Parameter display
If different signals are captured in the "ACCU" memory and the stored, the PM 3310 "remembers" both the attenuator and timebase settings. These can be recalled using the "SELECT" control and the appropriate memory display control. (An adjacent LED clearly indicates which stored signal parameters are being displayed).



The display parameters for each memory (i.e. at the time of capturing the signal) can be displayed at the touch of a button

Full screen displays
The contents of each of the four memories can be displayed over the whole screen. This facility enables signal details to be magnified and compared in a variety of modes, since once a signal has been captured and stored, its amplitude and position can be changed as required. In this operating mode the centre of the memory (offset control) and the centre of the screen (Y-positon control) are the same.


PM 3311

Dot display
Signals are compounded from a series of dots which the instrument "fills in" for display convenience.
If required the dots-only mode can be selected.

2-channel displays
Signals on channel A or B can be captured in the ACCU memory and stored in any of the other three memories. Alternatively the signals on A and B can be captured **together**, each occupying half the memory storage capacity, and stored in the same way. This facility enables up to eight signals to be captured, stored and analysed.

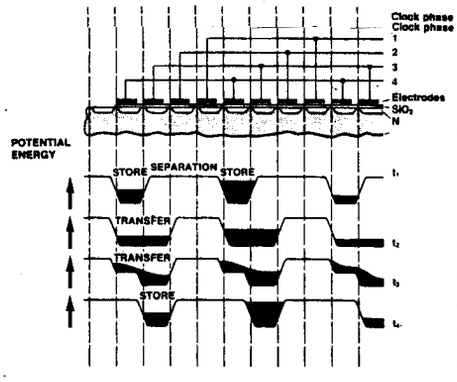
Multiple shot
In addition to the conventional single-shot facility, the PM 3310/11 feature the very useful "multiple-shot" mode. This enables more than one transient signal to be captured. The first is captured and transferred to STO3 automatically, the second diverted to STO2 and so on until all four memories are full. This makes it possible to capture the desired transient which can be related to other events.

Plot mode
This mode is used to give an output signal to an X-Y recorder. First one stored signal is plotted, then the other, the instrument giving a pen-lift signal between. For recorders without automatic pen lift, there is sufficient time for manual pen lift and return.

Roll mode
This useful facility enables each oscilloscope to function as a chart recorder. In this mode the signal runs from right to left, first in the ACCU memory which when full is copied into STO3, then into STO2 and 1, to give the equivalent of a continuous trace.

In the lowest time/div. setting this produces a display equivalent to a reading time of 40 hours.

The best of both worlds
The key to PM 3311's price/performance breakthrough is the unique, inhouse-developed "Profiled Peristaltic Charge Coupled Device" (P²CCD). Basically it allows data to be stored at rates up to 125 MHz and then to be sampled at a much lower rate (78kHz) by an LF ADC. To do this effectively replicates the signal in analog form by charging up 256 micro-minature semiconductor capacitiors in the device. They are often refered to as "wells". CCD devices perform three basic functions: storage, transfer and separation.



Signals are sampled at the clock rate (125 MHz) and each sample converted to a chargelpacket. The first packet enters the first well and by applying suitable clock pulses to the four groups of electrodes, it is possible to retain separation between wells and transfer the charge to the next well. The next sample then enters the device and the process repeats until the whole device is full. One then has a replica of the signal and this can be retained long enough for LF analog- to-digital conversion.

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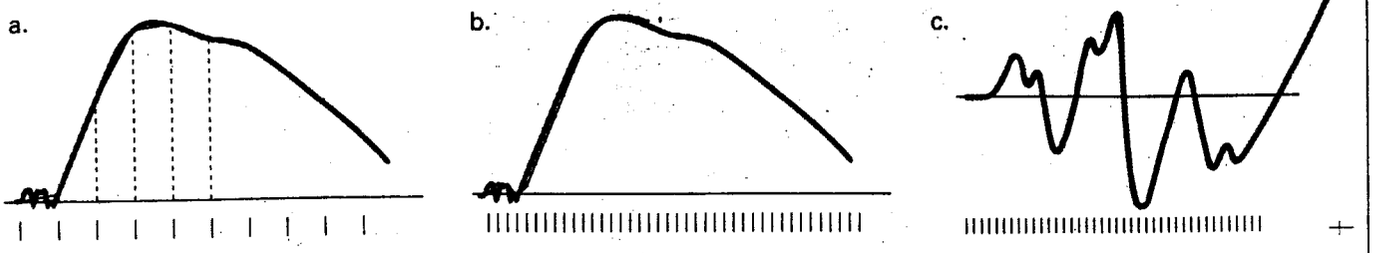

Closing up the digits
The importance of resolution in digital storage is not always fully appreciated. All instruments make straight line (or calculated) approximations from each measurement point, as shown in a. Thus at x20 the repetition frequency, as in a, it is entirely possible to miss completely the signal disturbance shown in b. Even at x80, the result shown in c lacks signal detail. This means that effective measurements of signals as low as 100 kHz can need a sample frequency of 80 MHz (x800) if signal detail is to be detected and stored.

TECHNICAL SPECIFICATION

CRT

Type
Philips rectangular tube with 10kV acceleration potential and metal backed phosphor

Screen type
P31 (GH) phosphor

Useful screen area
8 x 10div. of full centimeters

Graticule
Internal graticule with centimeter divisions and 2mm divisions along the central vertical axis. Shorter 2mm divisions along the second, fourth, sixth and eight horizontal axes. Illumination continuously variable.

Focus
Automatically adjusted

INPUT VERTICAL

Response
DC: 0Hz...60MHz
AC: 10Hz...60MHz

Rise time
6ns

Deflection coefficients
10mV...50V/div. in steps 1-2-5 sequence Uncalibrated continuous control between steps 1: > 2.5

The stored data can be displayed in a x5 mode. The smallest deflection coefficient wil then be 2mV/cm.

Automatic range indication
Automatic correct indication of deflection coefficient referred to probe tip if 10:1 attenuator probe with range indication is used.

Accuracy
± 3%

Input selection
- Channel A only
- Channel B only
- Channel A and B
- Channels A and B added
Channel B can be inverted

CMMR
> 100:1 up to 2MHz

Dynamic range
2 x voltage range

DC offset
± 4 x voltage range

Maximum sample rate
50MHz for PM 3310
125 MHz for PM 3311

Signal delay
>10ns visible display

Input impedance
1 MΩ in parallel with 25pF

Maximum input voltage
$400V_{DC} + AC_{pk}$

TIME BASE

Operation modes

a. *Single*
For single shot phenomena with sweep speeds from 0.2s/cm to 200ns/cm (500ns/cm for PM 3310): the accumulator will be overwritten with a new signal when the trigger level is passed and the adjusted trigger delay has been reached.

b. *Recurrent*
For repetitive signals with sweep speeds from 0.2s/cm to 5ns/cm: The contents of the accumulator memory is displayed on the screen. As soon as the trigger level is passed and the adjusted trigger delay has been reached the accumulator is overwritten with new data.

c. *Roll*
For strings of slow-moving signals with sweep speeds from 60min/cm to 0.5s/cm: the signal will be built up dot by dot from the right-hand side of the screen and moves in slowly. As soon sas the accumulator is completely filled up the contenets are copied in memory 3; the next time in memory 2, then memory 1 until the accumulator is filled up. When all four memories are completely filled the RUN LED's start blinking as an indication.

d. *Multiple*
Four successive single-shot signals are stored in the four different memories (dead time between two shots 20ms max.).

Time coefficient (for PM 3310)
Recurrent 5ns...0.2s/div.
Single shot 500ns...0.2s/div.
Roll 0.5s...60min/div.

Time coefficient (for PM 3311)
Recurrent 5ns...0.2s/div.
Single shot 200ns...0.2s/div.
Roll mode 0.5s...60min./div.

Accuracy
± 2%

Resolution
25 samples/div.

DISPLAY MODES

Memories
Each memory is displayed over 2cm screen height

Display combinations
- Accumulator display depends on input selection
- Information as stored in accumulator can be selected for storage in each of the three register memories and is displayed when display button is depressed. Total information stored in STORE 1, 2 or 3 can be inverted.

Vertical position range
± 8div.

Vertical expand
5 x each memory covers 10cm screen height. Indication of vertical deflection coefficient via LED is automatically corrected.

Horizontal expand
Continuously adjustable between 1 x and 2.5 x

X-Y operation
Deflection in X direction can be derived from time base or from memory contents derived from A-input

Dot join
At choice dots only or joined dots can be displayed

TRIGGERING

Trigger source
Internal Y_A, Y_B, External ÷10, Line

Level range
Auto: proportional to peak-to-peak value of trigger signal
Internal: ±3div.
External: ±3V
External ÷10: ±30V

Trigger sensivity

	Internal	External	External ÷10
at 60MHz	0.3div	0.3V	3V
at 40MHz	0.15div	0.15V	1.5V

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Slope
+ or −

Trigger modes and coupling
DC: DC...60 MHz
AC: 10 Hz...60 MHz
Auto: 20 Hz...60 MHz
TV-frame (1/1 picture): Acc to CCIR

External trigger input impedance
1 MΩ in parallel with 25pF

Maximum input voltage
$400V_{DC} + AC_{PK}$

TRIGGER DELAY

Range
−9...+9999div

Accuracy
0.2s...200ns(500ns)/div: ± 2mm
100ns(200ns)...5ns/div: ±2div. + visible delay

Indication
Accumulator and STORE 1.2.3 contain selected delay which can be displayed via LED display

PLOT OUTPUT

Horizontal
1V/full scale

Vertical
1V/full scale

Penlift
TTL compatible ("0" = pen down, "1" = pen up)

INTERFACE (optional)
Knob settings and memory contents (data as well as parameters) can be read and/or be controlled by a controller via IEC/IEEE instrument bus

CALIBRATION

Calibrated voltage
$3V_{pp}$ square wave 2.5kHz

Calibrated current
6mA square wave 2.5kHz

POWER

Line voltage and frequency
100...120V or 220...240V ± 10%, 50...400 Hz

Power consumption
65W at nominal line voltage

Batteries
Oscilloscope can be equipped with two 1.5V standard batteries (R6) for memory back-up

DIMENSIONS AND WEIGHT

(w x h x d) 316 x 154 x 460mm
(12.4 x 6.1 x 18-in)
12kg (26.3lb)

ENVIRONMENTAL CAPABILITIES

The following environmental data are valid only if the instrument is checked in accordance with the offical checking procedure. Details on these procedures and failure criteria are supplied on request by the PHILIPS organization your country, or by N.V. PHILIPS GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, HOLLAND.

Ambient temperatures
Rated range of use: +5°C...+40°C
Limits of operation: −10°C...+40°C
Storage and transport: −40°C...+75°C

Altitude
Operating: to 5000m (15000ft)
Non operating: to 15000m (45000ft)

Humidity
21 days cyclic damp heat 25°C...40°C R.H. 95%

Shock
30g: half sine wave shock of 11ms duration: 3 shocks per direction for a total of 18 shocks

Vibration
Vibrations in three directions with a maximum of 20min. per direction; 10min with a frequency of 5...25 Hz and amplitude of $1.016mm_{pp}$ 10min with a frequency of 25...55 Hz and an amplitude of $0.5mm_{pp}$. Maximum acceleration 3g. Unit mounted on vibration table without shock absorbing material.

Recovery time
Operates within 30min. coming from −10°C soak, going into room conditions of 60% RH at 20°C

Safety
Safety class 1 according to IEC 348

ACCESSORIES SUPPLIED

Front cover with storage space
Operating and service manual
BNC-Banana adapter
Contrast filter
2 x 10:1 attenuator probe with range indicator
Collapsible viewing hood
Cal terminal – BNC adapter

OPTIONAL ACCESSORIES

PM 8921	Passive probe 1:1 (1.5m)
PM 8921L	Passive probe 1:1 (2.5m)
PM 8927AS	Passive probe with range indicator 10:1, 11pF (1.5m)
PM 8927AL	Passive probe 10:1, 14pF (2.5m)
PM 8932	Passive probe 100:1, max. voltage 5600V; 2pF (1.5m)
PM 8940	High voltage isolation amplifier for floating measurements at $650V_{RMS}$
PM 8943	FET probe 650 MHz, 1:1/10:1/100:1
PM 8960	19-in rackmount adapter
PM 9355	Current probe 12 Hz...70 MHz
PM 9381	Oscilloscope camera
PM 8976	Camera adapter for stationary use
PM 9366	Collapsible viewing hood
PM 8980	Long type viewing hood
PM 8994	Set of accessories for probes
PM 8991	Oscilloscope trolley
PM 9051	BNC-4mm banana adapter
PM 8910	Polaroid anti-glare filter
PM 3325	IEC/IEEE interface
PM 9480	IEC-bus cable (length 1m)
PM 9481	IEC-bus cable (length 2m)
PM 9482	IEC-bus cable (length 4m)
PM 9483	IEC/IEEE (GPIB) cable adapter (length 1m)
PM 9483/51	IEC/IEEE (GPIB) adapter plug

IEEE/IEC INTERFACE DATA
Included in PM 3311: IEC connector fitted and IEEE adapter supplied.
For modifying standard PM 3310 a connector PM 3325 is optionally available. This also requires an IEC-to-IEEE adapter PM 9483/51 which has to be ordered separately.

Interface functions

SH1	Source handshake fully compatible
AH1	Acceptor handshake fully compatible
T6	Basic function, serial poll unaddress if MLA *Output data:* settings, data including parameters *Status data:* busy, ready/data, alarm ready
L4	Basic listening, unaddress if MLA Programming data: settings, memory data including parameters
SR1	Capable of sending a service request
RL2	No local lockout
PP∅	No parallel poll
DC1	Complete device clear capability
DT1	Complete device trigger capability